भारतीय मानक
Indian Standard

IS 16718 : 2021

कृषि वस्त्रादि — कृषि और बागवानी अनुप्रयोगों के लिए पोली प्रोपाईलीन स्पन बोंडेड बिना बुने हुए कपड़े के फसल कवर और फल झालर बैग — विशिष्टि

(पहला पुनरीक्षण)

Agro Textiles — Polypropylene Spun Bonded Non-Woven Crop Covers and Fruit Skirting Bags for Agricultural and Horticultural Applications — Specification

(First Revision)

ICS 59.080.30; 59.080.99

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भारतीय मानक ब्यूरो
BUREAU OF INDIAN STANDARDS
मानक भवन, 9 बहादुरशाह ज़फर मार्ग, नई दिल्ली – 110002
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI-110002
www.bis.gov.in www.standardsbis.in

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Technical Textiles for Agro-tech Sectional Committee, TXD 35

FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Technical Textiles for Agro-tech Sectional Committee had been approved by the Textiles Division Council.

This standard was first published in 2017 which covered the requirements for polypropylene spun bonded non-woven crop covers only. This standard has been revised to incorporate the requirements for polypropylene spun bonded non-woven fruit skirting bags also. In this revision following major changes have been made:

a) Title and scope have been modified;

b) Manufacture clause has been specified;

c) Table for requirements of fabric weight, and typical size of fruit skirting bags and fabric wraps have been specified;

d) Sampling and criteria for conformity has been modified; and

e) References to Indian Standards have been updated.

Crop Covers

Crop covers are generally non-woven fabrics made from polypropylene. Crop covers are generally placed over plants and seedlings to create a micro-climate which encourages early growth and development of crop with the valuable result of both improvement in quality and yield. The crop covers are also used to protect plants from cold and frost. Up to 5 °C circulating moisture is trapped by it and in the event of a frost, the fabric freezes like film providing the plant with natural frost protection.

a) Crop covers maintains comfortable temperature conditions by reducing convection heat loss, which provide protection against frosts and cold climatic conditions during winter season;

b) Crop covers allow adequate air, moisture, light and water transmission which provide optimum growing conditions for plants and seedlings underneath; and

c) Crop covers prevents crop from being damaged by insects, birds, small animals, etc.

Crop cover fabrics can be used very successfully by small and large farmers including kitchen gardeners for vegetables, fruits and flowers.

The weight of the crop cover used is a direct function of the degree of exposure that the field is subject to and the anticipated weather conditions. The greater the anticipated climatic exposure and the more severe the weather conditions the heavier the weight and stronger the fabric needs to be. Typical weights of spun-bond non-woven polypropylene fabric used as crop cover are 17 g/m^2 and 22 g/m^2. Being very light; it is very economical. The fabric has specialized UV absorbers incorporated in it which ensures protection against the sun’s rays.

Experience has shown that,

a) in isolated cases, where lightweight fabric is used in more exposed conditions than would normally be recommended, the fabric can get adversely damaged thus affecting the crop underneath.

b) a lot of the fabric is being reused for several different growing seasons. Consequently, a longer product life is expected than the fleece was originally intended to provide.

c) sometimes, there is a reluctance to use heavier weight fabric, in circumstances where it would be more appropriate, as this would reduce light transmission through the fabric has adversely affect the crop.

(*Continued to third cover*)

Indian Standard

TEXTILES — POLYPROPYLENE SPUN BONDED NON-WOVEN CROP COVERS AND FRUIT SKIRTING BAGS FOR AGRICULTURAL AND HORTICULTURAL APPLICATIONS — SPECIFICATION

(First Revision)

1 SCOPE

1.1 This standard prescribes the specification and performance requirements for polypropylene spun bonded non-woven fabric used for crop cover and fruit skirting bags for agricultural and horticultural applications.

1.2 While the standard refers various crops and vegetables for use of crop covers, and various fruits for fruit skirting bags, one should not interpret that this standard is applicable to only those crops, vegetables and fruits mentioned in this standard. The standard may be applied to other crops, vegetables and fruits, based on the pertinent available scientific data.

2 REFERENCES

The standards listed in Annex A contain provisions, which through reference in this text, constitute provision of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated in Annex A.

3 TERMINOLOGY

For the purpose of this standard, the following definitions shall apply.

3.1 Crop Covers — Thin sheets of polypropylene non-woven fabrics used as covering for protection of seedling and growing crop from change in climate like fog, rains and sunlight. Crop covers create a micro-climate by keeping soil temperatures higher than environment temperature, thus helping plants to grow faster leading to early harvesting and higher yields.

3.2 Fruit Skirting Bags — These are fabricated bags made of polypropylene non-woven fabrics used as covering for protection of growing fruits from change in climate like fog, rains, sunlight, diseases, insect bites and external damage. Fruit covers provide a suitable microclimate for fruits to grow faster, larger size and glossy skin with higher yields.

3.3 Spunbond Non-woven Fabric — Fabrics produced using continuous filament spinning process technology which also includes randomly laying of spun filaments in a uniform thickness web or fleece which is subsequently thermal bonded to achieve desired inter-fiber cohesion and strength to web. If such fabrics are produced from polypropylene polymer, the fabrics are called polypropylene (PP) spunbond non-woven fabrics.

4 TYPES

Based on the fabric mass, non-woven fabrics used to produce crop covers and fruit skirting bags are classified into two types:

a) *Type 1* — Having minimum mass of 17 g/m^2; and
b) *Type 2* — Having minimum mass of 22 g/m^2.

5 MANUFACTURE

5.1 Raw Material

Polypropylene raw material used for manufacture of non-woven fabric shall conform to the requirements specified in IS 10910, excluding overall migration. For stabilization against sunlight induced degradation, suitable UV stabilizer additives in required quantity shall be added.

NOTES

1 Non-woven fabric manufacturer may use maximum up to 10 percent of reworked in-house process waste (non-woven fabric waste), without compromising the final performance requirements.

2 All materials used for manufacturing of non-woven fabric shall be chosen in such a way that reprocessing of used crop covers and fruit skirting bags is promoted.

5.2 Fabric

5.2.1 The non-woven fabric used in the manufacture of crop covers and fruit covers shall be produced as flat fabric using spunbond process. The fabric shall be of white colour. If agreed between the buyer and the seller, pigmented coloured fabric may also be used. The fabric shall be suitably stabilized to ensure protection against outdoor weathering degradation.

5.2.2 The fabric width shall be 1.6 m or 3.2 m or as agreed to between the buyer and the seller, when tested as per method prescribed in IS 1954. The tolerance on width shall be ± 1 cm. The non-woven fabric is generally supplied in the form of rolls of length 400 m or 625 m or as agreed to between the buyer and the seller. The fabric length shall not be less than the declared value.

5.3 Crop Covers

Crop covers are the non-woven fabric of required width, which is used as it is, to make fabric tunnels, covering the growing crop in long parallel row. For wider tunnels, desired fabric width shall be achieved by longitudinal joining of two fabrics. The joining of fabric shall be accomplished by overlapping of the adjacently placed fabric edges and joining using stitching or heat sealing, hot air welding, ultrasonic welding, hot melt glue bonding and combination thereof.

5.4 Fruit Skirting Bags

5.4.1 Fruit skirting bags manufactured from polypropylene non-woven fabrics are available in two formats that are semi-fabricated and fabricated bags.

5.4.1.1 *Fabricated Fruit Skirting Bags* — For fabricated fruit skirting bags, flat non-woven fabric is converted into a rectangular bag of desired dimensions in two formats. In first case, two parallel sides are joined and other two parallel sides kept open. In second case, the bag is formed with three adjacent sides are joined with one side kept open. The joining can be done through stitching or heat sealing, hot air welding, ultrasonic welding, hot melt glue bonding and combination thereof.

5.4.1.2 *Semi-Fabricated Fruit Skirting Tubes* — These are produced from a continuous non-woven fabric of desired width and length. The fabric is longitudinally folded in the middle and the two edges of the fabric are overlapped and joined. The cylindrical fabric tube thus formed, is subsequently flattened before winding in the roll form. The edge joining can be done through stitching or heat sealing, hot air welding, ultrasonic welding, hot melt glue bonding and combination thereof.

5.4.2 The size (dimensions) and fabric GSM for fruit skirting bags and fabric wraps shall be as given in Table 1.

6 CONDITIONING AND TESTING

The fabric shall be conditioned and tested in standard atmosphere of 27 ± 2 °C and relative humidity of 65 ± 2 percent as per the method prescribed in IS 6359 and subsequently tested in this standard atmosphere.

7 REQUIREMENTS

7.1 The non-woven spun bonded polypropylene crop cover and fruit skirting bag shall conform to the requirements specified in Table 2.

Table 1 Fabric Weight (GSM) and Typical Size for Fruit Skirting Bags and Fabric Wraps

(*Clauses* 5.4.2 *and* G-2.2)

Sl No.	Fruit Type	Fabric Mass (GSM) *Min*	Skirting Bag Dimensions, Width × Height (mm)
(1)	(2)	(3)	(4)
i)	Mango, Orange, Sweet lime, Apple, Custard apple, Guava, Avocado, Pear, Lychee, Peach, Plum	17	(200 × 200) ± 5
ii)	Banana bunch	17	(800 × 1020) ± 5
iii)	Grape bunch	17	(250 × 300) ± 5
iv)	Pomegranate	22	(200 × 200) ± 5
v)	Papaya	22	(3000 × 1600) ± 5 (fabric wrap)
Method of Test, Ref to		IS 15891 (Part 1)	IS 1954 (*see* Note 3)

NOTES

1 Fruits stated in Table 1 are limited to the available data in literature. The usage of fruit skirting bags may be extended to other fruits based on scientific literature feedback and experimental trials. It shall not be construed that the fruit skirting bag are applicable only for the fruits mentioned in Table 1.

2 If the specific fruits require bag size other than specified in Table 1, buyer and seller to decide and agree on the appropriate bag size and applicable tolerances.

3 The dimensions shall be measured from stitch to stich or seal to seal line.

Table 2 Requirements of Non-Woven Spun Bonded Polypropylene Crop Cover and Fruit Skirting Bag

(*Clause* 7.1)

Sl No.	Characteristics	Requirement		Method of Test, Ref To
		Type 1	*Type 2*	
(1)	(2)	(3)	(4)	(5)
i)	Thickness, mm, *Min*	0.18	0.22	IS 15891 (Part 2) (Method A)
ii)	Fabric mass, g/m^2, *Min*	17	22	IS 15891 (Part 1)
iii)	Breaking strength, N/50 mm, *Min*:			IS 15891 (Part 3)
	a) Machine direction	30	35	
	b) Cross direction	20	25	
iv)	Elongation at break, percent:			IS 15891 (Part 3)
	a) Machine direction	55 to 100	55 to 100	
	b) Cross direction	55 to 100	55 to 100	
v)	Trapezoid tear strength, N, *Min*:			IS 15891 (Part 4)
	a) Machine direction	25	35	
	b) Cross direction	12	18	
vi)	Air permeability, cm^3/cm^2/s, *Min*	400	350	IS 15891 (Part 15)
vii)	Water vapour permeability, in g/m^2/day, *Min*	800	800	Annex B
viii)	UV stability test, retained strength after 144 h UV exposure, percent, *Min*:			Annex C
	a) Machine direction	50	50	
	b) Cross direction	50	50	
ix)	Ash content, percent, *Max*	1	1	Annex D
x)	Index puncture resistance, N, *Min*	10	15	Annex E
xi)	Water absorption capacity, percent, *Min*	50	50	IS 15891 (Part 6)
xii)	Colour	White or as agreed	White or as agreed	Visual

8 PACKING AND MARKING

8.1 Packing and Marking for Non-Woven Spun Bonded Polypropylene Crop Covers

8.1.1 *Packing*

The crop cover fabric of agreed width shall be in the form of neatly and firmly wound rolls. The fabric rolls shall have clear edges and free from telescopic winding. All fabric rolls shall be suitably protected by wrapping material to avoid fabric soiling and damage. The crop covers may also be packed as per agreement between the buyer and the seller.

8.1.2 *Marking*

The fabric shall be printed with identification mark of fabric manufacturer along with the information as required by the buyer using suitable inks, by flexography or any other suitable printing method. The marking shall repeat every 2 meters across the length of fabric and shall contain information about fabric manufacturer's name, brand logo, batch number and recycling symbol for polypropylene.

Each packed fabric roll shall be marked or labeled with the following information:

a) Name of the manufacturer or trade mark;
b) Fabric type and mass, in g/m^2;
c) Length and width;
d) Batch number or Lot number; and
e) Any other information as required by the buyer or the law in force.

8.2 Packing and Marking for Non-Woven Spun Bonded Polypropylene Fruit Skirting Bags

8.2.1 *Packing of Fabricated Fruit Skirting Bags*

8.2.1.1 *Fabricated Fruit Skirting Bags* — The fabricated fruit skirting bags of one size and shape, shall be packed in a bundle of 100 bags each. A compact bale of 5 such bundles, that is, total 500 bags shall be packed to form a bale. The bale shall be suitably protected by wrapping material to avoid bag soiling and damage. The fabricated fruit skirting bags may also be packed as per agreement between the buyer and the seller.

8.2.2 *Marking of Fabricated Fruit Skirting Bags*

Each packed bale shall be marked or labeled with the following information;

a) Name of the manufacturer or trade mark;
b) Fabric type and mass, in g/m^2;
c) Bag dimensions;
d) No. of bags in the bale;
e) Batch number or Lot number; and
f) Any other information as required by the buyer or the law in force.

8.2.3 *Packing of Semi-fabricated Fruit Skirting Tubes*

8.2.3.1 *Semi-fabricated Fruit Skirting Tubes* — The semi-fabricated fruit skirting tubes of agreed width shall be in the form of neatly and firmly wound rolls of each 200 m length. The rolls shall have clear edges and free from telescopic winding. All rolls shall be suitably protected by wrapping material to avoid fabric soiling and damage. The semi-fabricated fruit skirting tubes may also be packed as per agreement between the buyer and the seller.

8.2.4 *Marking of Semi-fabricated Fruit Skirting Tubes*

The semi-fabricated fruit skirting tubes shall be printed with identification mark of fabric manufacturer along with the information as required by the buyer using suitable inks, by flexography or any other suitable printing method. The marking shall repeat across the length of tube and shall contain information about fabric manufacturer's name, brand logo, batch number and recycling symbol for polypropylene.

Each packed fabric tube roll shall be marked or labeled with the following information;

a) Name of the manufacturer or trade mark;
b) Fabric type and mass, in g/m^2;
c) Tube dimensions;
d) Batch number or Lot number; and
e) Any other information as required by the buyer or the law in force.

8.3 BIS Certification Marking

The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act,* 2016 and the Rules and Regulations framed hereunder, and the product(s) may be marked with the Standard Mark.

9 SAMPLING AND CRITERIA FOR CONFORMITY

9.1 Lot

Crop cover fabric rolls or semi-fabricated fruit skirting tube rolls or fruit skirting bags having same fabric construction, same dimensions and produced under similar conditions shall constitute a lot.

9.2 Random samples shall be drawn from the lot for testing to be representative of the lot. The conformity of a lot to the requirements of this standard shall be determined based on the tests to be carried out on the samples selected from it.

9.3 Sampling and Criteria for Conformity for Crop Cover Fabric Rolls and Semi-fabricated Fruit Skirting Tube Rolls

Unless otherwise agreed to between the buyer and the seller, the number of crop cover fabric rolls or semi-fabricated fruit skirting tube rolls to be selected at random from a lot shall be in accordance with Table 3.

Table 3 Sample Size and Permissible Number of Non-conforming Pieces for Crop Cover Fabric Rolls and Semi-fabricated Fruit Skirting Tube Rolls

(*Clause* 9.3)

Sl No.	Lot Size (Number of Fabric Rolls or Tube Rolls)	Sample Size (No. of Fabric Rolls or Tube Rolls)	Sub-Sample Size (No. of Fabric Rolls or Tube Rolls)	Permissible No. of Non-Conforming Fabric Rolls or Tube Rolls
(1)	(2)	(3)	(4)	(5)
i)	Up to 50	5	2	0
ii)	51 to 150	8	3	0
iii)	151 to 300	13	5	1
iv)	301 to 500	20	8	1
v)	501 and above	32	12	2

9.4 Number of Samples and Criteria for Conformity for Crop Cover Fabric Rolls and Semi-fabricated Fruit Skirting Tube Rolls

It shall be as follows:

Characteristics	Number of Samples	Criteria for Conformity
Length, width and colour	As specified in column 3 of Table 3	No. of non-conforming rolls shall not exceed the corresponding value as specified in column 5 of Table 3
All other requirements	As specified in column 4 of Table 3	All the test pieces shall meet the requirements

9.5 Sampling and Criteria for Conformity for Fruit Skirting Bags

Unless otherwise agreed to between the buyer and the seller, the number of fruit skirting bags to be selected at random from a lot shall be in accordance with Table 4.

9.6 Number of Samples and Criteria for Conformity for Fruit Skirting Bags

It shall be as follows:

Characteristics	Number of Samples	Criteria for Conformity
Dimensions	As specified in column 3 of Table 4	No. of non-conforming bags shall not exceed the corresponding value as specified in column 5 of Table 4
All other requirements	As specified in column 4 of Table 4	All the test pieces shall meet the requirements

Table 4 Sample Size and Permissible Number of Non-Conforming Pieces for Fruit Skirting Bags

(*Clause* 9.5)

Sl No. (1)	Lot Size (Number of Fruit Skirting Bags) (2)	Sample Size (No. of Fruit Skirting Bags) (3)	Sub-Sample Size (No. of Fruit Skirting Bags) (*See* Note) (4)	Permissible No. of Non-Conforming Fruit Skirting Bags (5)
(i)	Up to 35 000	20	01	2
(ii)	35 001 to 150 000	32	01	3
(iii)	150 001 to 500 000	32	01	3
(iv)	500 001 and above	50	01	5

NOTE — For sub-sample, additional fabric from which the fruit skirting bags have been made may also be supplied to carry out the complete testing.

ANNEX A

(*Clause* 2)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*
1954 : 1990	Determination of length and width of woven fabrics — Methods (*second revision*)
6359 : 1971	Method for conditioning of textiles
10910 : 1984	Specification for polypropylene and its copolymers for its safe use in contact with foodstuffs, pharmaceuticals and drinking water
15891	Textiles — Test methods for nonwovens
(Part 1) : 2011	Determination of mass per unit area
(Part 2) : 2011	Determination of thickness
(Part 3) : 2011	Determination of tensile strength and elongation
(Part 4) : 2011	Determination of tear resistance
(Part 6) : 2012	Absorption
(Part 15) : 2017	Determination of air permeability

ANNEX B

[*Table* 2, *Sl No.* (vii)]

METHOD OF TEST FOR DETERMINATION OF WATER VAPOUR PERMEABILITY

B-1 PRINCIPLE

A test specimen is sealed over the open mouth of a test dish which contains water, and the assembly is placed in a controlled environment of 27 ± 2 °C at 65 ± 2 percent relative humidity. Following a period to establish an equilibrium of the water vapour pressure gradient across the sample, successive readings of the assembled dish are made and the rate of water vapour permeation through the specimen is calculated.

B-2 SAMPLING

The samples shall be selected from different places in the submitted sample to be representative of the whole. Minimum of 3 specimens from each sample shall be taken.

B-3 CONDITIONING OF THE SAMPLE

The samples need to be conditioned for minimum of 2 h in relative humidity of 65 ± 2 percent and the temperature of 27 ± 2 °C.

B-4 TEST PROCEDURE

B-4.1 Take care when handling the assembled dishes and avoid splashing the inside surface of the test specimen.

B-4.2 Condition the test fabric or sample at least for 2 h in the standard atmosphere for testing

B-4.3 Take three circular specimens each of approximately 9 cm diameter.

B-4.4 Using a burette, transfer the volume of water at 27 ± 2 °C into each open dish predetermined from the dimensions of the dish to give an air layer which is 10 ± 1 mm deep between the surface of the water and the underside of the supported specimens. This requires approximately 46 ml of water in each dish.

B-4.5 Position the triangular sample support in the dish.

B-4.6 Apply a continuous layer of adhesive to the rim of the dish. Position the test fabric such that the face side of the sample is uppermost in the assembly.

B-4.7 Place the cover ring over the rim of the dish and press firmly down.

B-4.8 Apply a strip of adhesive tape around the full circumference of the assembly sealing the join between the cover ring and the dish.

B-4.9 Place each assembly onto the turntable. Rotate the turntable with the assemblies for a period of 1 h to establish equilibrium of the water vapour transmission for each assembly.

B-4.10 At the end of the equilibrium period carefully weigh each assembly to the nearest 0.001 g and record the results.

B-4.11 Record the time these weighing was taken and then replace the dishes on turntable.

B-4.12 Rotate the turntable for a further period of 24 h.

B-4.13 Re-weigh the assemblies to the nearest of 0.001 g.

B-5 CALCULATION

Calculate the water vapour permeability by the formula as given below:

$$\text{Water vapour permeability, g/m}^2\text{/day} = \frac{24 \times M}{T \times A}$$

where

M = loss in weight, of assembly after 24 h, g;

T = time, h; and

A = area of the dish, m^2 (0.005 411 3 m^2).

Calculate the average water vapour permeability of 3 specimen readings.

ANNEX C

[*Table* 2, *Sl No.* (viii)]

UV STABILITY TEST

C-1 TEST SPECIMENS

The test specimens for tensile strength shall be cut from the sample as specified in IS 15891 (Part 3).

C-2 TEST CONDITIONS

C-2.1 The test shall be carried out with fluorescent UV-B lamp (313 nanometer or its equivalent).

C-2.2 The duration of the test shall be 144 h (that is 6 days).

C-2.3 The test cycle shall be 8 h at 60 ± 3 °C with UV radiation alternating after 4 h at 50 ± 3 °C with condensation.

C-2.4 Irradiation level throughout the test shall be maintained at $0.63^{+0.03}_{-0.0}$ W/m^2.

C-3 TEST PROCEDURE

C-3.1 Determine the original average tensile strength of shade net specimens separately as per the test specified in IS 15891 (Part 3).

C-3.2 Expose the specimens alternately to ultraviolet light alone and to condensation in one respective cycle.

C-3.2.1 The type of fluorescent UV lamp, the timing of the UV exposure and the temperature of condensation shall be as specified in **C-2**.

C-3.3 Determine the average tensile strength of the specimens separately after UV exposure as mentioned above.

C-3.4 Determine the percent retention of original tensile strength as follows:

$$\text{Percent retention of original tensile strength} = \frac{b}{a} \times 100$$

where

a = average tensile strength before UV exposure as obtained in **C-3.1**; and

b = average tensile strength after UV exposure as obtained in **C-3.3**.

NOTES

1 The UV source is an array of fluorescent lamps (with lamp emission concentrated in the UV range).

2 Condensation is produced by exposing the test surface to a heated, saturated mixture of air and water vapour, while the reverse side of the test specimen is exposed to the cooling influence of ambient room air.

ANNEX D

[*Table* 2, *Sl No.* (ix)]

DETERMINATION OF ASH CONTENT

D-1 PRINCIPLE

The procedure is used to find out the inorganic residue in non-woven crop cover sample by ashing it in a muffle furnace. A weighed amount of fabric sample is heated to 590 °C. The polymer sample (organic portion) is burnt at 590 °C until constant mass of inorganic matter is obtained. The residue (inorganic matter) is reported in terms of percentage ash content in a given sample.

D-2 APPARATUS

D-2.1 Weighing Balance, accurate to 0.001 g.

D-2.2 Silica Crucibles, sufficient volume to accommodate 3 g of sample in such a way that level of the sample after filling the crucible does not cross half the height of crucible.

D-2.3 Bunsen Burner

D-2.4 Silica Triangle and Tripod

D-2.5 Muffle Furnace, capable of being controlled thermostatically at 590 ± 10 °C.

D-2.6 Desiccator, containing an effective drying agent (for example silica gel) that does not react chemically with ash components.

D-2.7 Gloves and Crucible Holder

D-3 SAFETY

D-3.1 Burn the sample in an effectively ventilated hood.

D-3.2 Keep the hood closed and do not inhale the fumes of combustion.

D-3.3 Wear gloves and use sample (crucible) holder, to introduce crucible in the furnace.

D-3.4 Sample shall be folded properly to accommodate it in silica crucible.

D-4 PROCEDURE

D-4.1 Heat the clean crucible at 590 ± 10 °C for 10 to 15 min and cool it in a desiccator.

D-4.2 Weigh the empty crucible to nearest 0.001 g.

D-4.3 Weigh 3 g of non-woven crop cover sample in the crucible (nearest to 0.001 g).

D-4.4 Heat the crucible directly on burner so that the sample burns slowly, and loss of ash is avoided. Continue burning until no more smoke is evolved.

D-4.5 Transfer the crucible in the muffle furnace, which is already maintained at approximately 590 °C and keep the crucible inside for about 2 h.

D-4.6 Remove the crucible from the furnace and cool it to the room temperature in a desicator. Weigh it and record the weight to accuracy of 0.001 g.

D-4.7 Keep the crucible in the muffle furnace for another 30 min, cool in a desicator and weigh again. Repeat the procedure until constant mass is obtained.

D-5 CALCULATIONS

Percent ash content =

$$\frac{Weight\ of\ ash}{Weight\ of\ non\text{-}woven\ crop\ cover\ sample} \times 100$$

ANNEX E

[*Table* 2, *Sl No.* (x)]

TEST METHOD FOR INDEX PUNCTURE RESISTANCE

E-1 SCOPE

This test method is used to measure the index puncture resistance of polypropylene spun bonded non-woven fabric.

E-2 PRINCIPLE

A test specimen is clamped without tension between circular plates of a ring clamp attachment secured in a tensile testing machine. A force is exerted against the centre of the unsupported portion of the test specimen by a solid steel rod attached to the load indicator until rupture of the specimen occurs. The maximum force recorded is the value of puncture resistance of the specimen.

E-3 APPARATUS

E-3.1 Tensile/Compression Testing Machine, of the constant-rate-of extension (CRE) type.

E-3.2 Ring Clamp Attachment, consisting of concentric plates with an open internal diameter of 45 ± 0.025 mm capable of clamping the test specimen without slippage. A suggested clamping arrangement is shown in Fig. 1. The external diameter is suggested to be 100 ± 0.025 mm. The diameter of the six holes used for securing the ring clamp assembly is suggested to be 8 mm and equally spaced at a radius of 37 mm. The surfaces of these plates can consist of grooves with 'o'-rings or coarse sandpaper bonded on to opposing surfaces.

E-3.3 Solid Steel Rod, with a diameter of 8 ± 0.01 mm having a flat end with a 45° × 0.8 mm chamfered edge contacting the test specimen's surface (*see* Fig. 1 and Fig. 2).

E-4 TEST SPECIMEN

The test specimens shall be cut from the polypropylene spun bonded non-woven fabric and shall have a minimum diameter of 100 mm to facilitate clamping. If the 100 mm diameter sample is not available, smaller diameter may be taken provided sample is properly clamped.

E-5 CONDITIONING

Bring the specimens to moisture equilibrium in the atmosphere for testing (65 ± 5 percent relative humidity and 27 ± 2 °C temperature). Equilibrium is considered to have been reached when the increase in the mass of the specimen, in successive weightings made at intervals of not less than 2 h, does not exceed 0.1 percent of the mass of the specimen.

E-6 PROCEDURE

E-6.1 Select the load range of the tensile/compression testing machine such that the rupture occurs between 10 and 90 percent of the full-scale load.

E-6.2 Centre and secure the specimen between the holding plates ensuring that the test specimen extends to or beyond the outer edges of the clamping plates.

E-6.3 Test at a machine speed of 300 ± 10 mm/min until the puncture rod completely ruptures the test specimen.

NOTE — The rate of testing specified is not an indication of the performance of the specimen for its end use.

E-7 CALCULATION

Calculate the average puncture resistance and standard deviation for all tests as read directly from the recording instrument.

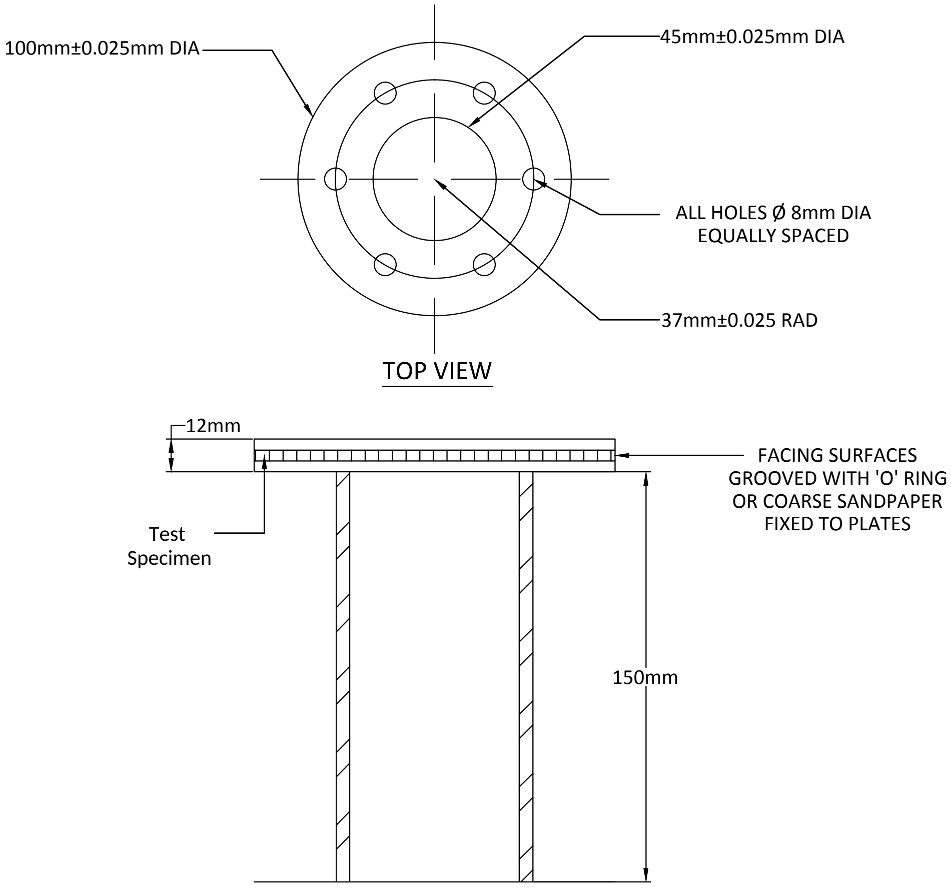

Fig. 1 Test Fixture Detail (Not to Scale)

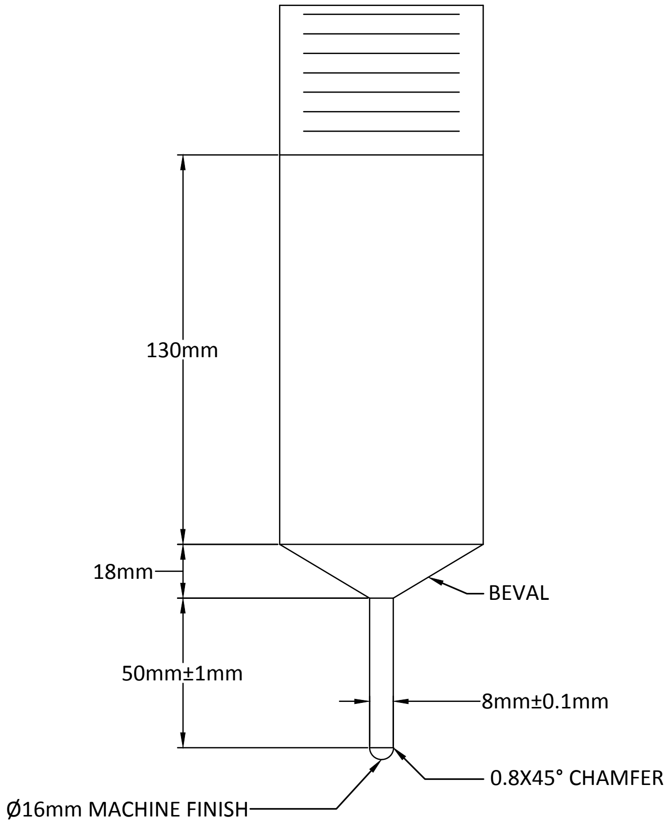

Fig. 2 Test Probe Detail (Not to Scale)

ANNEX F

(*Foreword*)

INSTALLATION GUIDELINES FOR CROP COVER/LOW TUNNEL

F-1 PREAMBLE

F-1.1 The primary function of agricultural crop cover is to provide favorable micro-climate to the plants by partially controlling the atmosphere and environment by reducing both light intensity and effective heat by allowing air, sun light and moisture hence, round the year seasonal and off season cultivation is possible except in rainy season. This enables prolonging the harvesting period and as well as flexibility of off-season cultivation depending upon the conditions and the type of crop under crop cover/low tunnel.

F-1.2 Crop covers are typically cladded on an inverted frame structure made from materials such as PVC pipes, steel wires, wood or bamboo and is known as crop cover/low tunnel in which crops are grown successfully. The success of crop cover/low tunnel depends particularly on appropriate and proper installation and the quality of materials used for its construction. Crop cover/low tunnel gives manifold production of good quality produce from the same land area as compared to the open cultivation.

F-2 LOGISTICS

Crop covers are packed and transported by appropriate means to protect them from any type of damage. Rolls or bundles of crop cover are loaded manually or with a crane and can be unloaded in a similar manner at the destination. Use of hooks shall be avoided for loading and unloading of the crop cover bundles or rolls at site.

F-3 STORAGE AT SITE

F-3.1 The crop cover shall be stored on levelled surface to protect them from any damage, dirt, grease, water, moisture, mud, mechanical abrasions or excessive heat and shall be stacked not more than three layers of rolls or bundles.

F-3.2 The owner of the site where the crop cover is to be installed shall provide storage space in a location sufficiently near the crop cover structure to minimize any additional handling.

F-3.3 The storage area shall be protected from theft, vandalism, vehicular traffic and any other source which could create potential damage to the crop cover.

F-4 PLANNING FOR A CROP COVER/LOW TUNNEL

F-4.1 Before starting a crop cover installation, grower shall carefully study the climate and its influences on the growth of the crops intended to be grown. The following parameter need to be taken into consideration for its success:

a) Climate, soil and water, topography, accessibility of the area and the opportunities for transport and marketing, protection against fluctuating temperatures, solar radiation, heavy rain, hail and strong wind.
b) Type of soil, soil profile and the location. If possible, choose soil with a good structure in a flat area for the crop cover/low tunnel project.
c) It is very important to have enough and good drip irrigation system to irrigate and leach the soil.
d) A good infrastructure for transporting materials and products is also of importance, just like the availability of electricity.

F-4.2 Planning of Production

Planning of production to include what to plant, when to plant, how much to plant, and what quantities are required. Market accessibility for selling the produce intended to be grown, if necessary, to switch to other crops is also an important factor.

F-4.3 After consideration of the above factors, size of the crop cover/low tunnel need to be selected based upon the cultivation of crop selected, market access and experience of crop cover/low tunnel cultivation. It is suggested that growers to start with small sizes crop cover/low tunnel as it would require less initial capital investment along with operational expenditure however, provision shall be made for future expansion also. Along with the above, experienced farmers and entrepreneurs can decide on size of crop cover/low tunnel depending upon scale of cultivation area. The cost may vary depending upon the types of crop cover/low tunnel and number of suppliers' present in the region.

F-5 STRUCTURAL MATERIALS

A crop cover/low tunnel consists of two basic components that is inverted U shaped structural component (made of either PVC pipes, steel wire, wood or bamboo materials) and non-woven fabric as cladding materials. The U-shaped structural component provides support for cladding materials. The selection of U-shaped structural component shall possess adequate strength to withstand the load of row of crop cover. There are different sizes of U-shaped structures available as per crop pattern.

F-6 SELECTION OF CROP COVER

F-6.1 Crop covers of minimum weight of 22 g/m^2 are commonly made from spun-bonded polypropylene nonwoven fabric and are placed on supports over crops or floated over the tops of stronger, mature plants. These crop covers protect plants from frost damage down to -2 °C and from strong winds, heavy rains, and even hails, but allow light, air, and water to reach plants. These crop covers allow from 70 to 85 percent of sunlight to reach plants and can be used for light shading in summer and can also be used to exclude insects and other pests early in the growing season.

F-6.2 Crop covers of minimum weight of 17 g/m^2 are commonly used to protect plants from insects, birds, and insect-borne diseases and transmit up to 95 percent of sunlight to plants. These covers are used for protection from frost in winter and heat in summer and readily allow rain and irrigation to reach plants.

F-7COMMENCEMENTOFCROPCOVER/LOW TUNNEL INSTALLATION WORK

F-7.1 Appropriate fencing shall be put around the crop cover/low tunnel to prevent stray entry of men and animals to protect any damage to the crop cover.

F-7.2 Prepare the bed, by rotary tilling or, more preferably, aerating and loosening the soil with a spading fork. Although the length of the bed is determined by the available space, most commonly beds are 5 to 6 feet in width; width can be made narrower, if growing plants with a taller height than most greens.

F-7.3 Insert one end of a 10-foot length of ½-inch PVC pipe into a hole. (User can use inverted U-shaped GI steel wire of 4 mm diameter with minimum 275 g/m^2 of zinc coating or bamboo pieces for the purpose).

F-7.4 Insert the other end of the PVC conduit into the opposite hole, creating a hoop over the bed (User can use inverted U-shaped GI steel wire of 4 mm diameter with minimum 275 g/m^2 of zinc coating or bamboo pieces for the purpose). Avoid stepping on the prepared beds and folded over bed and end about to be inserted into opposite hole.

F-7.5 Repeat the process of constructing hoops every 15 feet down the length of the bed (User can use inverted U-shaped GI steel wire of 4 mm diameter with minimum 275 g/m^2 of zinc coating or bamboo pieces for the purpose).

F-7.6 Unroll the low tunnel cover of appropriate weight and width along the length of the bed (Most crop covers are available in 10-foot widths; however, size and width of crop cover depend on crop pattern and width of soil bed).

F-7.7 Pull the crop cover over the bed. At the longest ends of the bed, gather the cover and cinch it tightly with a durable rope (such as woven clothesline). Tie the other end of the rope to a secure stake. Repeat on the other end of the bed, pulling the cover taut.

F-7.8 In case of crop cover of 17 g/m^2, secure only the edges of the cover with available weights and then cover edge of fabric by soil also along soil bed. Typical photographic representations of crop cover/low tunnel are given in Fig. 3A, Fig. 3B and Fig. 3C.

F-8 POST INSTALLATION PRECAUTIONS

Crop covers usually last up to 2 years with proper care and if the season length is not too long. Once installed, plants can be watered directly through the drip irrigation. Weeds will grow very well in the microclimate created under the crop cover and it is essential that weeds be controlled for maximum crop production. To weed the covered plant beds, remove crop cover from one side (preferably the leeward side if there is any breeze). After pulling weeds, reinstall the crop cover and all staples. To minimize the need to weed, plastic mulch can be used under the crop cover. As the plants grow, the crop cover will be lifted, providing protection for the plants. The crop cover can be left on until the plants pull the slack out of the crop cover. At this point, the crop cover must be removed to enhance plant growth. Remove the crop cover when dry and roll it up, paying attention not to damage it and store for another season. Store in a dry place that is free of rodents.

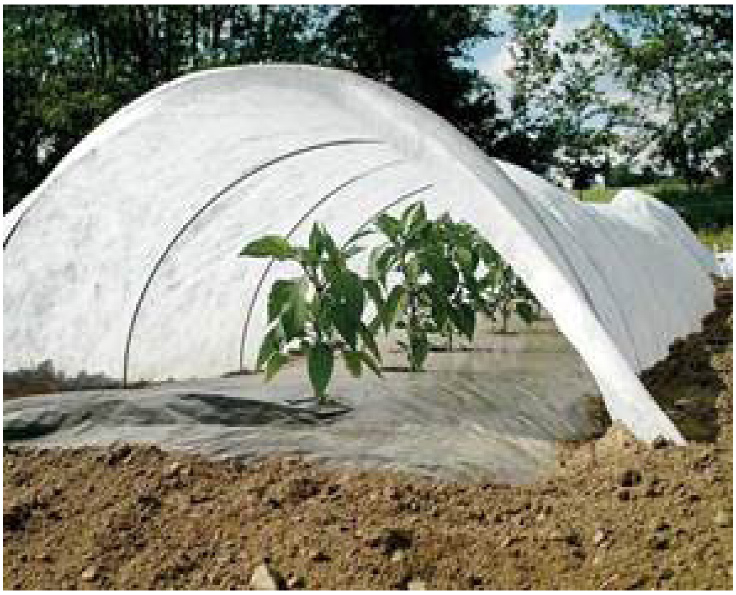

Fig. 3A

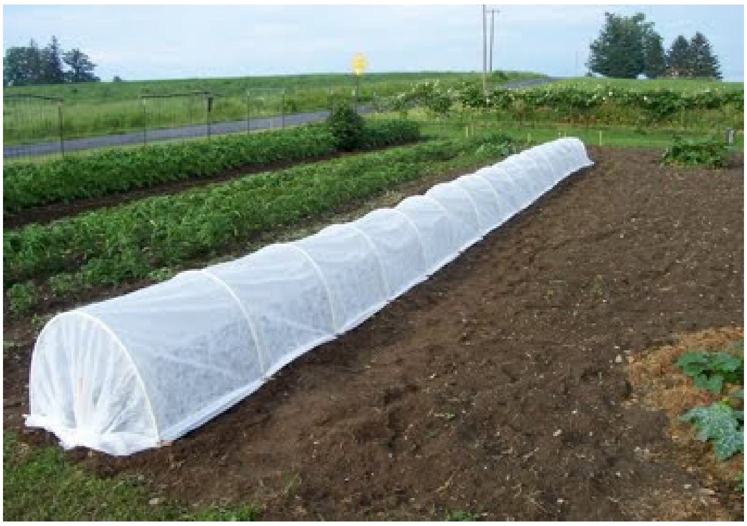

Fig. 3B

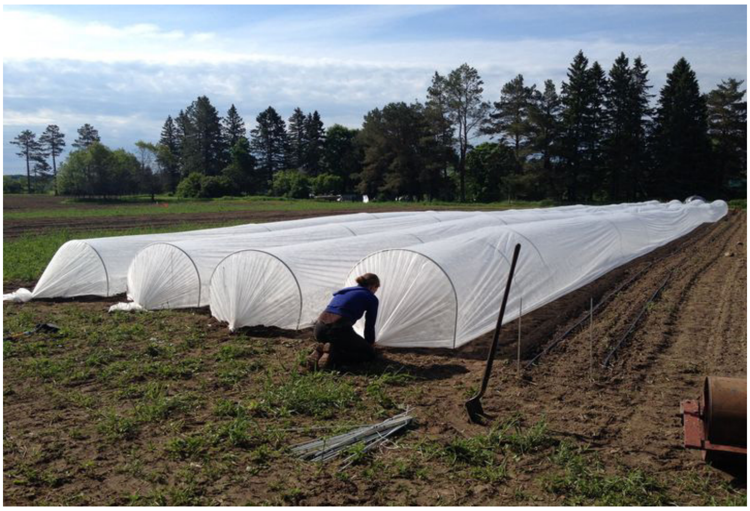

Fig. 3C

Fig. 3 Typical Photographic Representation of Crop Covers

ANNEX G

(*Foreword*)

INSTALLATION GUIDELINES FOR FRUIT SKIRTING BAGS AND COVER WRAPS

G-1 INTRODUCTION

G-1.1 Pre-harvest fruit bagging has emerged as an effective method to improve fruit quality and yield. Fruit skirting or covering is a physical protection method which not only improves the visual quality of fruit by promoting skin colouration and reducing blemishes but can also change the micro-environment for fruit development, leading to several beneficial effects on internal fruit quality and yield. Due to its many beneficial effects, fruit skirting has become an integral part of fruit harvesting.

G-1.2 Selection of type of non-woven fabric, the type of fruit skirting bag used, the stage of fruit development when the fruit is bagged, the duration of fruit exposure to natural light following skirting bag removal, and/or fruit and cultivator specific responses, all these factors influence the final quality of fruit and the yield. Fruit skirting and bagging is a laborious process, and its cost-benefit ratio should be investigated and fine-tuned for optimized results.

G-1.3 Fruit bagging is commonly employed for mango, orange, sweet lime, apple, custered apple, guava, avocado, pear, lychee, peach, plum, pomegranate, papaya, banana bunch, grape bunch, etc. Typical photographic representations of fruit skirting bags and fruit covers are given in Fig. 4A, Fig. 4B, Fig.4C, Fig. 4D and Fig. 4E.

G-2 TYPES OF FRUIT COVERS

G-2.1 There are two types of fruit covers commonly used, such as appropriate size cut-piece of non-woven fabric as simple cover around the growing bunch of fruits or certain portion of the tree. The other type is, use of fabricated skirting bags of appropriate size.

G-2.2 The fruit skirting bags are manufactured from polypropylene non-woven fabric. For bag fabrication stitching or heat sealing, hot air welding, ultrasonic welding, hot melt glue bonding and combination thereof may be used. The fabric mass and typical bag sizes used for various fruits are given in Table 1.

G-3 EQUIPMENT AND ACCESSORIES

Non-woven fabric cut pieces, fabricated bags, plastic clips, zip ties, thin metal wire twist ties, sharp cutter or knife blade, scissors, stapler.

G-4 BAGGING PROCEDURE FOR SOFT AND HARD SKIN FRUITS

G-4.1 Carefully observe the fruits on the tree and decide whether the single isolated fruit to be bagged or bagging of fruit bunch is necessary and accordingly choose the appropriate size of the bag to be used. Ensure the fruit stem is clean and free of obstructions for tying the bag. If necessary, obstructing leaves around the stem may be trimmed.

G-4.2 For fabricated fruit skirting bags, first select the right size bag. Cut 5 mm off each of the two bottom corners of bag with scissors to create small size opening. This will facilitate drainage when rainwater gets into the bag. Take the bag near to the fruit and slide-in the young fruit into the bag from open top, just far enough so that the top portion of the bag is gathered around the fruit stem and tied with a clip or a metal wire twist tie string.

G-4.3 For semi-fabricated fruit skirting bags, first cut the required length of fabric tube from the roll for installation. Gather the one end of the tube, say bottom end, with a clip or tie pin or a metal wire twist tie string. Ensure that tying is slightly loose, so it facilitate water drainage from the bag in rainy season. Take this skirting tube near to the fruit and push the young fruit into the bag from the open top. Gather the top end of tube fabric around the fruit stem and tie it to the stem by means of either with a clip or tie pin or a thin metal wire twist tie string.

G-4.4 For many fruits of larger size or where the complete or partial covering of tree is recommended, fabric wraps of appropriate size are used. In this installation, the fabric cut piece of required size is taken and is simply wrapped around the fruit or fruit bunch and secured by tying it with the stem using suitable tying technique.

G-5 BAGGING PROCEDURE FOR BANANA BUNCH

G-5.1 Check and monitor banana fruit development daily after the flower bract begins to lift away from the first bunch or hand of bananas on the stalk. Banana plants typically expose one more bunch every day once fruits begin to appear.

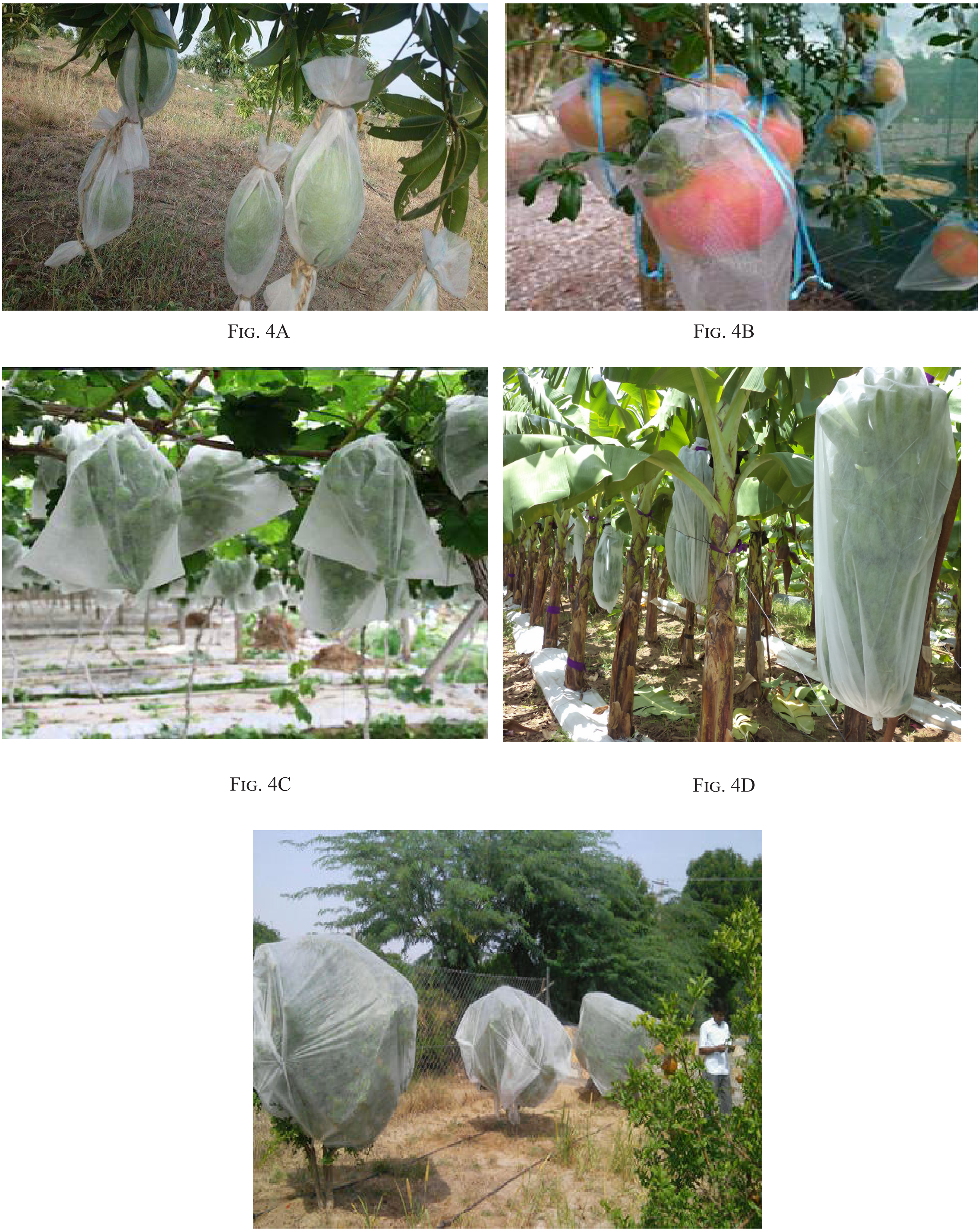

FIG. 4A

FIG. 4B

FIG. 4C

FIG. 4D

FIG. 4E

FIG. 4 TYPICAL PHOTOGRAPHIC REPRESENTATION OF FRUIT SKIRTING BAGS AND FRUIT COVERS

G-5.2 Wait three weeks after the final bunch of bananas is exposed to cover the fruits. This gives the soft young bananas time to firm up to the point that these can withstand handling. The fruit skins will become tough enough to tolerate the friction that a covering bag exerts on them.

G-5.3 For bagging of banana bunch, slide the bag up over all the banana bunches till the bag top reaches the top stalk of the bunch. Gather the end of the bag top around the stalk well above the top fruit bunch. Secure it to the stalk with a piece of string or clip or metal twist wire. Leave the bottom of the bag open to allow for air circulation, if necessary. This also keeps the fruits from overheating inside the covering. If not needed, gather the hanging bag bottom and close it with suitable tying technique.

G-5.4 Leave the skirting bag in place until the final bunch of bananas is harvested.

G-6 TIPS

G-6.1 Once fruit is bagged, spraying of insecticides or pesticides is not required for the remainder of the season.

G-6.2 Bunch covers may slightly accelerate fruit ripening and hence care shall be taken to harvest the fruits accordingly.

G-6.3 While commercial non-woven bags are available in different colours, it has not been proven and established that any specific colour has better performance over other coloured bag.

ANNEX H

(*Foreword*)

COMMITTEE COMPOSITION

Technical Textiles for Agro-Tech Sectional Committee, TXD 35

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Central Institute for Research on Cotton Technology, Mumbai	Dr N. Vigneshwaran Dr P. K. Mandhyan (*Alternate*)
Central Institute of Plastics Engineering and Technology (CIPET), Chennai	Dr Abdul Kader Shri Rajiv Kumar Lilhare (*Alternate*)
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Organization	*Representative(s)*
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Member Secretary

Shri J. K. Gupta
Scientist 'E' (Textiles), BIS

(*Continued from second cover*)

d) for multiple width joined fabrics, when considering the physical properties of the fabric the entire width of the glued fabric shall be considered. In particular, the physical properties of the fabric on and around the glue line must be considered as these properties differ in certain critical aspects from those of the body of the fabric, particularly tear strength.

Crop covers can be used in different ways. In one of the methods, the fleece is laid flat directly on top of the ground. Several rolls of 3.2 m wide fabric are often joined together to form a single fabric up to 16 m wide. A typical method of joining this fabric is via the use of continuous ultrasonic method. In another method, the crop cover is predominately used stretched and supported over hoops. In this environment the crop cover does not come into direct contact with either the plants or the ground.

These fabrics can be laid both manually and mechanically. Generally, they are laid just like a film. Since they are very light, they must be handled with extra care. When laying sufficient margin over and above the normal field width must be allowed for growth and securing. They must neither be too loose nor tight, especially in the direction in which the wind is or may blow. The fabric must be secured at the edge: a spade full of earth at regular intervals will generally be adequate. The fabric is reusable for the next season, if not damaged. The tension must be adjusted suitably depending upon the crop. Nowadays crop covers are being used for crops like strawberry, chillies, tomato, leafy vegetables, melons, brinjals etc.

Fruit Skirting Bags

Several good agricultural practices (GAP) are becoming popular all over the world to produce good quality fruits with less dependence on insecticides and pesticides. Among several such practices, pre-harvest fruit and fruit bunch skirting, also known as, fruit bagging or fruit covering has emerged as one of the important productive method.

Fruit skirting is a physical protection method using non-woven fabric bags or simply fabric covers which creates a physical barrier to the fruit or fruit bunch from extreme weather and improves the physical appearance of fruit by promoting skin colouration, gloss, shine, and reducing blemishes. Fruit skirting also modify the micro-climate around the fruit, which can have beneficial effects on internal fruit quality, increased average fruit size and the overall yield per tree. Fruit skirting can also reduce the incidence of disease, insect pest and/or mechanical damage, sunburn of the fruit skin, fruit cracking and bird damage. Researchers reported that fruit appearance and size under fruit skirting bags improves which is one of the major factors of influencing a consumer for the fruit.

The fruit skirting bags shall be white or light in colour to avoid attraction by insects or bees.

Fruit skirting bags can be used very successfully by small and large farmers for fruits and fruits bunches. Fruit bags are being used for mango, orange, sweet lime, apple, custard apple, guava, avocado, pear, lychee, peach, plum, pomegranate, banana bunch and grape bunch, papaya, etc.

The installation guidelines for crop covers and fruit skirting bags are given in Annex F and Annex G respectively for information only.

The composition of the Committee responsible for the formulation of this standard is given in Annex H.

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated, expressing the result of a test or analysis shall be rounded off in accordance with IS 2 : 1960 ‘Rules for rounding off numerical values (*revised*)’. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002
Telephones: 2323 0131, 2323 3375, 2323 9402 *Website*: www.bis.gov.in

Regional Offices: *Telephones*

Central : Manak Bhavan, 9 Bahadur Shah Zafar Marg
NEW DELHI 110002 — 2323 7617, 2323 3841

Eastern : 1/14 C.I.T. Scheme VII M, V.I.P. Road, Kankurgachi
KOLKATA 700054 — 2337 8499, 2337 8561, 2337 8626, 2337 9120

Northern : Plot No. 4-A, Sector 27-B, Madhya Marg
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